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THE AMERICAN

# GAS-LIGHT JOURNAL AND CHEMICAL REPERTORY

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Devoted to the Interests of Illumination, Heating, Ventilation and Sanitary Improvement, Domestic Economy, and General Science.

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## Blake's Boiler Feed Pump, Etc.

These pumps are designed for feeding boilers, or forcing water under heavy pressure, with or without hand power attached. They are arranged in two different styles, one for cold water, the other for hot water. When both hot and cold water are to be used, order the hot water pump.

There is no longer any question as to the most economical manner of feeding boilers. It is to supply a steady flow exactly equalling the evaporation. The Blake pump does this: A pump capable of supplying one hundred horse-power boilers may be run so slowly as to supply the exact quantity of water evaporated by a one-horse boiler.

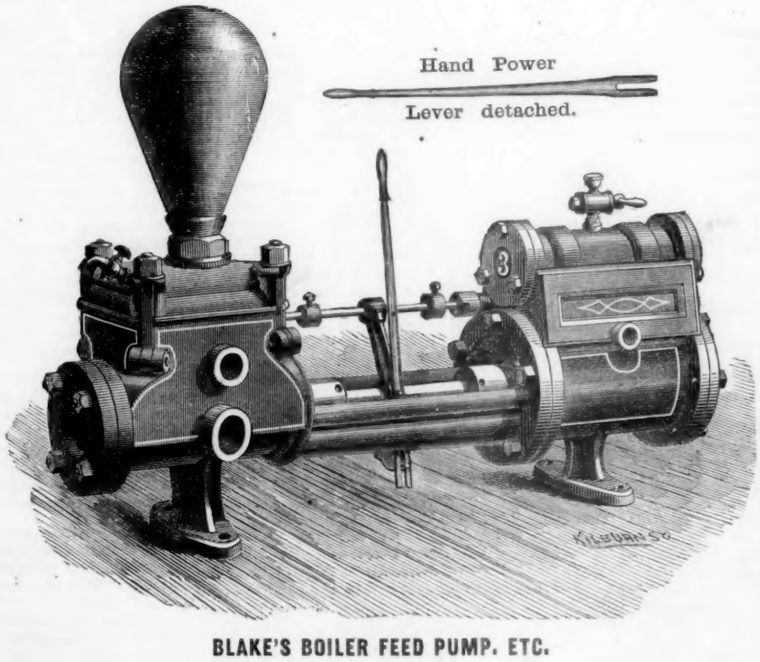
These pumps are well adapted for various other purposes, which engineers will understand, by the character of the pump as represented above. It is peculiarly adapted to the wants of gas works, when water is to be raised for condensing, scrubbing, washing, etc.

The illustration herewith shows clearly, the general features of the pump.

The utility of Pump with hand power attachment will be seen at once, as the Pump can be used, when steam is down, for filling boilers, washing decks, fire purposes, and to do general pumping. When the pump is being operated by steam the hand lever can be removed simply by lifting it from the pin on which the fork rests. Practical engineers will appreciate this feature.

They are made also of larger sizes of various proportions of steam to water cylinder, and of any desired capacity, to order.

For further information address Geo. F. Blake and Co., Manufacturers, No. 79 Liberty St., N. Y.




BLAKE'S BOILER FEED PUMP, ETC.

## Meteorology.

In the matter of meteorology the Americans are doing good service. They are endeavoring to establish a thorough and far-reaching system of study of storm phenomena. Industry, humanity, and science will all benefit from the enlightened labors of the American authorities who have taken up this matter. The disclosures touching storm signals are very interesting. In September, 1863, the fleet at Toulon had four hour's warning of a gale, which, by acting upon the warning, it rode out in perfect safety. Italy was also warned at the same time, and there, as in France, officers on shore were ordered to their vessels, and authorities on shore took measures to see that merchantmen should be able, or at least warned, to meet the gale.

It is gratifying to notice the degree of success that has attended the application of science in this department. In England, for instance, under the direction of the accomplished and lamented Admiral Fitzroy, 50 per cent of the prognostications of 1863-64 were verified, and 73 per cent of those of 1864-65. Of one hundred warnings sent to the coast of France in the winter of 1864-65, seventy-one proved correct, and in the following year 65 in the 100 were justified. The efficiency of the observers, as may be expected, improves from day to day. In the first of the winters referred to, the storms foretold were 89, and in the second, 94. In this matter of storms, future scientific accuracy may be reasonably expected. Great advances have been made in relation to the building, sailing, and steering of ships, and to finding their positions at sea; it is to be hoped that increased attention and enlarged knowledge will distinguish the labors of the experts whose scientific powers are applied to the subject of storms. By the system elaborated by Admiral Fitzgerald, thirty-two reports are received daily from the United Kingdom, and five from the Continent. These are based upon details of barometrical and thermometrical observations, and upon the direction and force of the wind, the differences between the wet and dry bulb, condition of the sky, the amount and time of falls of rain and snow, and sea phenomena or disturbance.—*Mechanics' Magazine.*

## Modern Aqueducts.

With that sublime audacity of conception which distinguished Californians, they are going for a supply not only to the very summit of the Sierra Nevada, but over it, to the Nevada slope. They have dammed the Truckee just below its point of exit from Lake Tahoe, and they will proceed to tunnel through the Sierra Nevada, and carry the water down nearly 300 miles, supplying five cities on the way—Auburn, Sacramento, Vallejo, Oakland, and San Francisco, crossing the Sacramento twice and the bay once. There is a mining canal, the Eureka, in El Dorado county, which is 450 miles long, and many other hundreds of miles long, but they are only ditches. What this will cost is not estimated yet, the amount is so immense. If San Francisco and Sacramento ever drink the waters of that lake, they will quaff the purest crystal supplied to any great city on earth. Floating on its surface, you can look down and watch the trout far, far below, darting about, absolutely incapable of concealment. Enter it for a bath, and though you may count yourself a practised swimmer, you will find yourself floundering about, and able to keep afloat only with the utmost exertion, so light, so wonderfully pure are the waters. It is said that no man drowned in Lake Tahoe has ever been recovered. In a country of such atmosphere and such water do you wonder that the old Spaniards, and the Americans who took to wife their daughters, have begotten and reared twenty, twenty-five, or thirty children apiece?—*San Francisco Scientific Press.*

PITTSBURGH has thirty-two iron, nine steel, and two copper mills. The daily consumption of the iron mills is 1,200 tons, and their annual production $23,000,000. There are forty-eight foundries.

# Chemical Repertory,

**No. 44.—January 2, 1871.**

**Editor—Henry Wurtz.**


## AMERICAN CHEMICAL NEWS.

[ORIGINAL COMMUNICATION.]

### THE DISCUSSION ON PHOTOMETRY.

[The following communication from Mr. STIMPSON, constitutes a most valuable and important chapter in this grand controversy, which was initiated in the columns of this Journal December 2, 1869, by the publication of Prof. SILLIMAN'S paper; and which is now in progress in those of our London contemporary, strangely enough, however, with a total ignoring of most important papers that have been published by us from time to time, from Mr. FARMER himself, and others.—H. W.]

BOSTON, December 8, 1870.

Prof. HENRY WURTZ.

Dear Sir: In the last issue of the AM. GAS-LIGHT JOURNAL you mentioned Mr. Pole's deduction for the relation of light to consumption.

I enclose you herewith a copy of the abstract of my paper on that subject, read before the American Association for the Advancement of Science, on August 23, as it is to appear in the Proceedings. If not inconsistent with your plans, will you please have it published in the GAS-LIGHT JOURNAL. I think that you will see a close correspondence between my conclusions and Mr. Pole's.

I send you also for inspection a copy of the theoretical curves, and of the results of the experiments at Paris in 1867. This last diagram shows conclusively how important a part the burner plays in producing light.

Yours,

FRED. E. STIMPSON.

[Mr. Stimpson's diagram, which is very interesting, we shall reproduce in our next.—H. W.]

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[Copy from the Proceedings (in advance of publication) of Troy Meeting Am. Ass'n Adv. Science.]

### A GRAPHICAL DISCUSSION

OF THE VARIOUS FORMULÆ PROPOSED FOR THE RELATION BETWEEN THE QUANTITY OF LIGHT PRODUCED BY THE COMBUSTION OF ILLUMINATING GAS, AND THE VOLUME OF GAS CONSUMED.

BY FREDERICK E. STIMPSON, BOSTON, MASS.

[Abstract.]

He found, upon examination, that three formulæ had been proposed for this reduction, namely:

1. The common one $\frac{l}{l'} = \frac{g}{g'}$ which is expressed by saying that the quantity of light $l$ is proportional to the quantity of gas $g$ consumed.

2. That produced and used by Bunsen and Roscoe, page 884, vol. 149, Phil. Trans. for 1859.

$\frac{l-l'}{l'-l''} = \frac{g-g'}{g'-g''}$ which is expressed by saying that for a given burner, the increase of light is proportional to the increase of the quantity of gas consumed.

3. And finally "Farmer's formula," proposed by Prof. Silliman, at the Salem meeting of this Association. $\frac{l}{l'} = \frac{g^2}{g'^2}$ which is expressed by saying that the light is proportional to the squares of the consumption.

These three formulæ transformed so as to express the value of $l$ become—

$(1^b)\ l = \frac{l'}{g'} - g$ or $l = Ag$.

$(2^b)\ l = \frac{l-l''}{g'-g''} g - \frac{l-l''}{g'-g''} g''$ or $l = Ag - B$

$(3^b)\ l = \frac{l'}{g'^2} g^2$ or $l = Ag^2$

Mr. S. had collected from various publications upward of 120 independent series of determinations of the relative illuminating power of gas consumed at various rates from different burners. These burners comprised single jet, union jet or fishtail, slit or batswing, and argand: and each set contained from two to ten single determinations. These series, together with some of his own determinations, were represented in the form of curves, and by means of the magnesium lantern, projected on a screen for inspection.

From the results of observations thus far made, he concluded that Bunsen and Roscoe's formula (a straight line cutting the axis $g$) would represent the greatest number of series, and particularly the series belonging to the argand burners.

That for those series belonging to the jet, the fishtail, and batswing burners, the common formula, a straight line passing through the origin, which is a modification of Bunsen's, in which B=0, very closely represents the relation found by experiment.

Whereas the number of cases in which the series, or any considerable part of the series, could be represented by a parabola (formula 3) were very few.

He found, however, that when a gas flame was on the verge of its smoky condition, a tangent to the curve would almost always pass through the origin, showing that for a limited range of consumption at that point, the light is proportional to the consumption.

One other point was also very apparent: such is the influence of the burner upon the flame, that in order to get the best results for any given consumption, the burner must be the kind best fitted for that particular consumption.

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[ORIGINAL COMMUNICATION.]

## LECTURES
### *AT THE PEABODY INSTITUTE,*

BY PROF. HENRY MORTON,

[The following are Reports of Lectures recently delivered at the Peabody Institute by Professor HENRY MORTON, President of the Stevens Institute, in Hoboken. They owe their interesting and graphic style (next to the lecturer himself of course) to the ability of the reporter, Mr. J. T. WATKINS. Additional value and authority are given by the personal correction and revision of the author, who communicated them to us. We see it announced that in a few weeks the New York public is to be gratified by lectures from Professor MORTON, on kindred subjects, at the American Institute; of which we shall hope to present reports to our readers.—H. W.]

### On "LIGHT," with Experiments.

[Revised and Communicated to this Journal by Prof. MORTON.]

The opening lecture last night of the General Course filled the large and beautiful hall of the Peabody Institute with a fashionable, attentive and delighted audience, of whom fully one-half were ladies. In view Prof. MORTON said:

It is important to start out with a clear idea of the theory as to the nature of light, which our experiments will develop and illustrate. Briefly that theory is that light is due to a vibration in the transmitting medium analogous to the waves produced and visible in water, or—a better illustration—those produced in air by sound, which may also be made visible. It was formerly thought that light was a substantial emanation proceeding from the source which produced it. But the velocity of light is 1,000 times greater than that of a cannon ball at the instant it leaves the gun; therefore if the supposed substance of light were 1,000 times lighter than the ball, it would produce equal effect upon the object it should strike. Indeed, were it 1,000,000 times lighter, it would still possess effective power sufficient to take off any heads a beam of it might fall upon. But all the experiments I shall show you are explicable upon the theory that light is a vibration or succession of waves, and are wholly inexplicable upon the theory that it is an emanation. We suppose light to be transmitted throughout the universe by means of a medium occupying all space; nor does the wave movement require that there should be any forward or progressive movement in any particle of the medium itself, as I will now show you. An ingenious experiment, devised by Prof. ROOD.

FIRST EXPERIMENT.

The gas being turned down, the reflection of a sinuous line of points was thrown upon the screen and made to exhibit a wavy motion, like a huge snake, though still without making actual progress with a single point. * * * Next to illustrate the theory of "interference," according to which one set of light waves might encounter and destroy another set of light waves, the lecturer showed the points of light approaching each other in wave line, and becoming mutually reduced to a straight one. "When I come to polarize light, I will show you brilliant and beautiful experiments by which you will see the destruction alluded to I now illustrate it by the analogous case of sound."

SECOND EXPERIMENT.

The professor here placed on the table an apparatus called a "resonateur," to resound or multiply the volume of sound, and make it audible when the sound itself is not. Then took a tuning fork and by the resonateur showed how the sound-waves from the two tines might mutually destroy each other, while yet each, when singly returned from the resonateur, was sounding vigorously. This was an experiment first developed by Prof. A. M. MAYER. Then took a second fork in accord with the first, and showed how they two mutually destroyed each other. Placed them out of accord, and produced a succession of swelling and dying chords as the vibrations of one fork successively destroyed, or ceased to destroy, those of the other. These very neat experiments were designed to illustrate by analogy the action of light-waves, and were received by the audience with demonstrations of delight.

MORE EXPERIMENTS.

Next, the lecturer explained the composition of light, and after the lights had been turned down produced a beautiful and intense spectrum upon the screen. Next, he turned a beam of yellow light through the prism, and lo! the yellow beam alone appeared, the other colors going to the composition of white light were not in the yellow beam. Then the property by which certain substances absorb rays of a certain color was illustrated by passing the beam through a colorless liquid, whereupon, in place of the yellow ray of the spectrum, a black band appeared.

SOUND ANALOGIES AGAIN.

To illustrate the property by which bodies that absorb a particular ray of light give back the same, the tuning forks were resorted to, and one was made to communicate its tone to another which was in accord, while utterly refusing to do so when out of accord. Then followed an explanation of the action of the prism in decompsing light, for which a lucid, though elaborate diagram was very neatly thrown upon the screen. To this succeeded a representation of the spectroscope upon a large scale. It is impossible to give an idea of the beauty of these illustrations to one who may never have seen them.

THE SOLAR SPECTRUM.

Then followed the reproduction on the screen of a photograph of a portion of the solar spectrum, crossed by the famous black lines, and fully explained, together with the series of experiments by which they are proved to be due to volatilized iron—or iron in the state of vapor—in the atmosphere of the sun, together with various vapors of known composition, while the absence of still others—as of copper, bismuth, etc.—was equally proved. And then was exhibited the photograph (always by the powerful lantern upon the screen) of the rays to the right of the violet rays, which are invisible to the eye.

Another curious analogy was shown to subsist between sounds—which, while theycannot be heard, will cause other substances to resound—and rays, in themselves invisible, which will cause other substances to give off visible rays. This is "fluorescence" or "phosphorescence"—not in the sense of that phosphorescence caused by the slow combustion of the chemical substance "phosphorus." The lecturer then combined, by a clever little apparatus, the separate prismatic colors and produced a large circle of white light. This illustration was very beautiful. After explanation of the complimentary colors, and the conventional sense in which they might hereafter be spoken of, the professor proceeded to the

GRAND EXPERIMENS OF THE EVENING

in illustration of the properties explained as "fluorescence" "and phosphorescence." "For this purpose I use an apparatus of electrical induction, the largest yet made in this country, and undoubtedly the most efficient yet made any where. There was a larger one in England, which has, however, lctely entirely broken down, from inherent faults of construction.

FLASHES OF FORKED LIGHTNING

were then produced, full fifteen inches in length, accompanied by prodigious crackling. The length of flash was then shortened, and its brilliancy increased to a livid vividnes, almost blinding. A glass goblet, colored canary with uranium, was placed in an exhausted receiver, and flashes of the electric fluid made to illuminate it. The property of "fluorescence" appeared, as the graceful outline of the vase tinted a golden olive, appeared in a bath of tender violet. Flashes were afterwards passed through other vessels with effects so brilliant and beautiful that the full audience could not repress the enthusiastic expression of their delight.

ILLUSTRATIONS OF PHOSPHORESCENCE

were to close the lecture. The electric fluid was first passed through three tubes which forthwith flashed brilliant sheets of blue and green and yellow, and when the current was arrested, continued "phosphorescent" for some time. The experiment was repeated to renewed applause.

"But probably the

MOST BEAUTIFUL EXPERIMENT

in this dirfiction is what I shall now show you in phosphorescent gas. I have here a tube which, for a wonder, reached here from Germany safe. This is a single

tube of glass wound around into this complex coil, and with these numerous knobs blown upon it. This tube contains within it a little of the vapor of anhydrous sulphuric acid, and has the property of phosphoresence to a truly wonderful degree." The fluid is passed through, the globes glow with blue and green light. "Now, observe what happens when I stop the discharge." The globes continue to glow—growing gradually faint—and the audience again heartily applaud.

FINALLY,

to illustrate the proposition that where but a single ray exists all other colors disappear, the lecturer draped some crimson and green cloths upon the stage, and turned up two flaming pyramids of *yellow* light. The lecturer became of a dull olive color, the crimson and green cloths were a nondescript black grey; the beautiful faces that a moment before had flushed and blushed as though conscious of their own loveliness, took on a greenish waxy look, and people with consciences about them, began to realize what things were going to look like "down below." Each woman was a fright, and every man a horror.

So the gas was turned up, and Prof. Morton said his next lecture would be on "Sources of Light."

[To be continued.]

## Photometry as Applied to the Estimation of the Value of Coal Gas.

By Messrs. T. N. Kirsham, C. E., and W. Sugg, A. I. C. E.

[The following lecture was delivered at the meeting of the British Association of Gas Managers, held recently.]

[Continued from page 164, vol. xiii.]

An examination of the various diagrams demonstrates that the differences in the candles may be classed under five heads, viz.:—1. Difference in the illuminating power of parliamentary standard candles, burning at the rate of 120 grains per hour. 2. Differences in the illuminating power of normal standard candles, burning at the rate of 135 grains per hour. 3. Candles with different rates of consumption giving the same amount of light. 4. Candles with the same rates of consumption giving a different amount of light. 5. Greatest differences of illuminating power in the whole number of experiments when corrected to the parliamentary standard.

From tabulated results of three other sets of experiments belonging to this series, it appears that in one (diagram No. 4), where the consumption of sperm varies from 109·2 grains to 134·4 grains, the greatest difference in the illuminating power of the gas, corrected to the parliamentary standard, is 4·59 candles. In the next (diagram No. 5), where the consumption ranges from 120·9 grains to 130·8 grains, this difference is 3·06 candles; while in the third (diagram No. 6), with a consumption of from 120 grains to 142·5 grains, the difference is 4·21 candles.

As the Institute of Civil Engineers have considered these investigations of sufficient importance to induce them to make a special publication of them for the use of their members, which is probably in the hands of most of you, it will be unnecessary for us to detain you further in respect to them. We beg only to remark, that the unsuitableness of a sperm candle for the purpose of a standard is so conclusively shown, that it remains with the gas referees to justify its continued adoption.

The difficulty is the selection of such a standard. As the French system of photometry has been very well spoken of at different times by those who are qualified to form an opinion on this subject, it will be now the proper time to explain to you shortly what it is.

First, then, the standard of comparison is colza oil, refined in a peculiar manner, and carefully verified by proper persons appointed by the municipality of Paris for the purpose. The process cannot be given here for want of time, but I may mention that the same oil is used for all the government lighthouses in France, and is also tested chemically and otherwise by the officers belonging to this department. Up to the present time they have without doubt managed to keep the oil practically to the original standard, as arranged by Dumas and Regnault about twelve years ago.

It is consumed in a carcel or moderator lamp. This is the kind of lamp fitted with proper glasses, both lamp and glasses made to a perfect pattern.

The kind of photometer used is that called Foucaults's photometer, which is a modification of the original Count Rumford's photometer, a diagram of which is here.

It will be seen, by reference to the colored diagram of the French photometer, that the two lights to be compared—the gas and lamp—are placed side by side.

The rays from each light fall upon a disc of glass, paraeed with ground rice so as to be rendered opalescent.

Now, as to whether the lamp burning colza oil is more reliable than the standard candle, we unhesitatingly answer in the affirmative. In the first place it is readily adjusted, and the required consumption of oil can be obtained, even by inexperienced operators, in a very short time. A moderately experienced operator will get it within a few grains every time. Once adjusted it will burn without any very sensible alteration for two or three hours together.

To show you how reliable it is as a standard, we shall refer you to the diagrams marked "Theory of Jet Photometer and Duration Test."

On the first—on the diagram, "Retrograde Scale"—you will see a number of red stars. Each of these red stars represents three experiments performed at the French photometer in a very ordinary manner. Understand clearly that no extra care was taken to make the lamp burn well—not so much as would be taken by an ordinary operator—yet you will see that the regularity of the red stars is much greater than that of the black quatrefoil, which represents the average of twelve experiments with sperm candles, each quatrefoil.

The widest lamp experiment is 1½ candle out; the widest candle experiment is 1.8 candle out. The difference is not great between the two in appearance, but when you consider that the quatrefoil represents twelve experiments, while the red star represents only three, it will necessarily follow that had the same number of experiments been performed with the lamp as with the candles, they would all been much closer to the truth. More than this, in these experiments several variations were made in the management of the lamp—for instance, in some experiments it was allowed to burn for ten minutes before commencing the first experiment; in others it was lighted, and the experiment commenced in about two minutes. Again, in some experiments the lamp continued to burn untrimmed from the first to the last; in others it was trimmed every time. So that you will see no favor was shown to the lamp at all. The candles, on the other hand, were doing their best in the hands of trimmed operators.

Shortly, then, if the lamp is properly trimmed and allowed to burn, as defined by the French authorities, half an hour before being used for experiments, we think that, as a standard, it will be far before the candles in reliability and ease of manipulation. You will have no trouble with the standard, burning more or less than it ought. The exact quantity required may be readily fixed, and a very slight alteration only will take place after it has been burning for an hour or two.

Probably it will be objected that it is impossible to make use of a French model carcel or moderator lamp for English testing, because the method of gas examination as arranged by Dumas and Regnault is so totally different to ours, that the public would not understand at all what is meant by a 22-litre gas or a 20-litre gas. Permit us to set your minds perfectly at rest on this score; we do not propose to ask the public to do anything of the sort.

The new Evans's lamp photometer, which is here, settles that difficulty at once. The operator reads off the scale in true standard sperm candles, the same as with any other instrument provided with candles as a comparison. No calculation is necessary on the part of the operator to convert the terms of the lamp into those of the true sperm candle. A short description of the instrument will prove this to you.

Like the ordinary Evans's photometer this requires no dark room, both the standard light and that for the gas to be examined are enclosed so as not to be affec- by extraneous light, although they are all closed to the admission of an abundant supply of air without draughts.

The disc, which is fixed, is not, in the one before you, in the middle of the photometer scale, but nearer to the lamp. The scale on the left side of the disc goes from 1 at the disc to 30 on the left of the disc. The value of a lamp of the Paris model burning the same kind of oil as that used by the municipality of Paris, at the rate of 648 grains per hour, is, we have found 9.6 candles; that is average well-made sperm candles such as are used for gas-testing purposes all over the country. Therefore the lamp is placed at that distance from the disc which is equal to the distance marked on the scale for 9.6 candles, whatever that may be. No calculation, therefore, is required.

The gas, which is made to move by means of a simple action worked by a pinion of 10 into a wheel of 100 in a smooth steady manner, is brought by the operator into that position in which it illuminates the left side of the disc to the same extent as does the lamp that on the right. The figure on the scale at which the pointer stops represents candles—this, suppose the pointer is found at 14, then the gas is equal to 14 sperm candles, supposing the lamp to have burned at the rate of 648 grains per hour.

Diagrrm No. 10 shows by inspection the correction required to be made for any variation in the consumption of oil by the lamp. The balance upon which the lamp hangs is one designed by Mr. Keates, one of the gas examiners for the Metropolitan Board of Works, a gentleman who has had great experience in the testing of gas and oil. You will observe it is much lighter than that devised by my illustrious confrere Adrien Deleuil of Paris, a name well known in the scientific world of that capital.

It will turn readily to half a grain when loaded; Deluil's turns to three-quarters under the same circumstances. A simple spot of mercury at the tail of the beam on the supporting crutch is made to complete the circuit of a current of electricity when the quantity of oil required is consumed, and either to stop the clock, or by the ringing of a bell to call the operator's attention to that fact. This method of ascertaining when the lamp had burned its proper quantity was adopted in the construction of the "cross" photometer, and used in all our experiments, and was found to be very effective.

Mr. Mann, of the City of London Gas-Works, has kindly lent us a clock which he has arranged so that it can be stopped and started by electricity, or by the hand, at the option of the operator

The regulation and measurement of the gas is effected in the ordinary way by means of a clock-meter, governor, and microscopic adjustment.

The *modus operandi* of the experiment is similar to that described in the gas referees instructions—viz., ten minutes observations—the only difference being that 108 grains of oil are consumed instead of 40 grains of sperm candle.

What, then, is the outcome of all these experiments, and how do they apply to the general every-day business of the supply of gas? This is what we shall now proceed to show. First, then, the great desideratum for the gas manager is an uniform quality of gas. Irregularities tn the purity of gas are only discovered after a careful chemical examination; and, till they are told of it, the majority of consumers are, unless in very bad cases, totally unaware of the presence of impurities in the gas they are burning. Snch is not the case with regard to illuminating power. Any falling off in that respect manifests itself at once to every consumer. The eye is a very good photometer, and persons who have been accustomed to read or work by the same light every night readily detect a difference. Nor does it necessarily follow that in all such cases the gas is, as consumers say, bad or defective in illuminating power. Not at all; the difference may be in this, that the gas complained of may be quite up to the standard, or even beyond it, but from some cause or other it is not quite so good as that which may have been supplied on previous nights, which was, perhaps considerably above the standard. Therefore, we maintain that it is quite as injurious to the consumer to supply him with gas of a higher quality than the standard or normal gas which he is prepared to consume, and for which his burners may be arranged, as it is to take the contrary course. The desideratum is uniformity of quality, which is to be obtained, without any large amount of trouble, by all.

[To be concluded.]

## The Great Gas Explosion at Worcester, Mass.

Through the courtesy of Mr. I. N. Stanley, of Brooklyn, N. Y., who has recently returned from attending the funereal cermonies of the victim of the sad accident, Hon. James B. Blake, Mayor of Worcester, we are able to give more complete particulars. From Mr. Stanley's verbal description, and a copy of the *Worcester Evening Gazette*, which he kindly furnished, we gather the following facts:

The explosion occurred about half past seven o'clock, P. M., on Friday December the sixteenth, at the works of the Worcester Gas Company, which shook the city to nearly as great an extent as did the memorable dualin explosion last summer. Windows rattled, door bells rang and people were frightened in nearly every part of the city, while despatches were received from Grafton, Milbury, and other tows within a radius of a dozen miles, announcing its manifestation there, and asking the cause.

THE CAUSE OF THE EXPLOSION.

The cause of the explosion is given as follows by the employees of the works:

A new purifier had been put in during the day, and the workmen had carelessly left a stop-cock, or a pipe open, which should have been closed. This allowed an extensive leak of gas, which filled the building, a large brick structure. The Superintendent of the works, Hon. James B. Blake, Mayor of the city, had been absent for two days, and was visiting the works to see that everything was in order, and, accompanied by Timothy McAuliff, the foreman, who carried a lantern as they went about the yard, approached the purifying house. Mr. Blake opened the basement door to look in, to see that all was right, when the escaping gas was

ignited from the lantern in the hands of McAuliff, who was behind Mr. Blake, on the steps leading to the basement, and the explosion followed instantly, tearing the building to pieces, shattering the windows of other buildings near by, and demolishing several wooden structures in the vicinity, the fragments of which were whirled in the air and scattered in every direction, for some distance.

SERIOUS RESULTS.

Mr. Blake, who was just entering the door, was thrown into the basement, by the recoil of the air, and was badly burned about the face and hands, his hair and beard being considerably singed; he was also shaken and bruised by the shock and the flying fragments, but remained on the ground, directing the employees, till all danger of further explosion was over, when he was taken to his residence on West street, in a carriage, and attended by the family physician. Mr Blake'e carriage was standing near by, and was completely wrecked by the force of the explosion. The horse was not hurt. McAuliffe was directly behind Mr. Blake, when the explosion occurred, but from some cause was much more severely burned. His hands, face and head were scorched entirely black by flames, every particle of hair being burned off, the crisped hair and blistered skin giving the top of his head the appearance of a covering of close clipped wool. He was taken to his home. No. 8 Lafayette St., and his burns were dressed by Dr. Joseph Bates and Dr. Park. He is improving steadily, and is likely to recover without permanent injury.

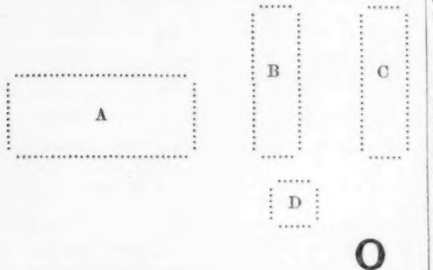
The clothing of neither of the injured men was burned, and except about their heads and hands. they were apparently not seriously injured. It seems surprising that they escaped instant death, or that in the scorching flash of the ignited gas, their eyesight was not destroyed.

The accident interrupted the manufacture of gas for several days, leaving the city reduced for the time to the necessity of using oil and candles.

PLANS AND DESCRIPTION OF THE PREMISES.

That the interest of the people to learn all the particulars of the recent explosion at the gas works is unabated is evident from the large number of people who have visited the scene of the disaster. To those who have not personally inspected the premises a description of the same may be of interest, and a clearer idea may be obtained from the annexed plans. The following is a

PLAN OF THE ENTIRE PREMISES.



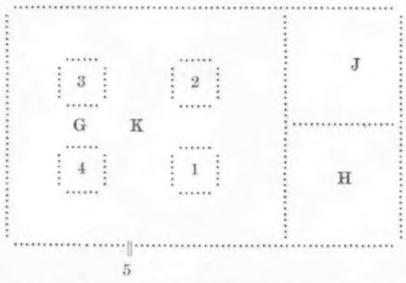

In this plan the top is the south, bottom north, right hand west and left hand east. "C" represents the coal shed, a long brick structure adjacent to the Providence and Worcester Railroad, from which a branch track runs into the roof of the building and the coal is dumped into the building beneath; this shed will hold between five and six thousand tons of coal. It is built in the most substantial manner and has a heavily slated roof. The explosion forced the roof up into ridges, smashed all the windows, but did not materially damage the walls.

"B" is another long brick structure and is called the "retort house" It has an iron truss roof and stone floor. The centre of the building is occupied by a large structure of fire brick, with six furnaces on each side; each furnace heats five retorts, which are large horizontal tubes made of clay and shaped like this: D; each tube is 15 inches wide, 20 inches high and over seven feet long. This building had the windows all broken, but the retorts escaped injury.

"A" represents the "purifying house" where the explosion occurred. "D" is the office, containing rooms for the Directors and the Superintendent of the works. It is situated on the edge of a high embankment, and is two stories in height. In the lower story is the station metre, a huge drum shaped machine, nine feet in diameter and weighing ten tons. The offices are in the second story on a level with the gasometer. This building sustained a little damage beyond breaking the windows. The gasometer is situated in a round house, 90 feet in diameter and 32 feet high, represented by the letter "O"

The following shows the ground plan of

THE PURIFYING HOUSE.




This building was of brick divided into four apartments. "H," contained the condensers, "J" the exhauster and "G" the purifiers, while a room over "J" contained an engine that ran the exhauster. "1," "2," "3," and "4" represent the purifiers, which consist of large cast-iron chambers fitting into tanks supported by brick arches "1" was the most injured, "2" the next, and "4" is in the best condition. Under the purifiers, and in the centre of the basement, is a large cast-iron valve "K," which receives the gas from the exhauster, which then passess into one purifier, then back to the valve, next into another purifier, then bank again, and into a third purifier, from which the gas returns into the valve, and then passes through the station meter into the gas-holder. At "5" is the door into the basement where the Mayor and Mr. Mc Anliffe came in contact with the gas which had escaped into the building.

The walls of the purifying house were almost entirely demolished, but gas can be made without working to rebuild the walls. Workmen are engaged clearing up the ruins and also in repairing the purifiers, the only part of the works necessary to the manufacture of gas that were injured. Work will be pushed forward with all possible speed.

It appears that the injuries to the works are much less than was at first supposed, or would be imagined by those who have visited the scene. The building where the explosion took place is of course wrecked, but the machinery is for the most part uninjured. The only damage is to the purifiers. Mr. Jones Superintendent of the South Boston Gas Works, has made an examination, and thinks he can get one of the purifiers—marked 4, above—in operation again in a day or two. The directors of the company, who are using every exertion to expedite repairs, hope to be able to furnish gas to some extent, to morrow evening.

EFATH OF MR. BLAKE.

Mr. Blake died of the injuries he received, on Sunday the 18th Dec. He was universally beloved and a personal loss is felt by all classes of people. His remains were largely attended by the military and civic bodies, the Masons, the Odd Fellows, the Firemen, the Irish and German Societies, and deputations from various Gas Companies.

[Our space will not suffer us to give more than a few lines on this sad result of the explosion, but will give a more detailed account of his obsequies in our next issue.—EDS.]

## Explosion of the Cincinnati Gas Works.

At five P.M. Dec. 19, a terrible explosion occurred at the Gas Works. At the time of the explosion the holder contained four hundred and fifty thousand cubic feet of gas. Persons who were within a few squares of the site of the Gas Works first noticed a low, rumbling sound, and an oppressive condition of the atmosphere like that attending an earthquake, when suddenly red and white colored flames shot upwards, lighting up the heavens and revealing the outlines of the surrounding hills. The report of the explosion was heard at a distance of several miles. The eight immense columns that supported the holder were thrown down and for the most part broken to pieces. Some portions fell across the roof of the office, crushing it in and making a wreck of the place. The holder was constructed of No. 12 guage iron, and was regarded to be one of the best in the United States, and was erected in the place of one that was destroyed by an explosion in the summer of 1869. It has a capacity of 480,000 cubic feet. The buildings of the company in the neighborhood of the holder were somewhat scorched by the flames, and were othnrwise injured by the flying and falling masses of iron. No person was at the holder when the explosion occurred, and at present the cause is unknown. Only one man was injured, and he slightly, by the fire, although forty men were at work at the retorts a few hundred feet away. The loss to the company will be about $100,000

## The Chemical History of a Candle.

BY PROFESSOR FARADAY,

[A Course of Six Lectures delivered before the Royal Institution of Great Britain.]

### LECTURE VI.

CARBON OR CHARCOAL—COAL-GAS—RESPIRATION AND ITS ANALOGY TO THE BURNING OF A CANDLE—CONCLUSION.

A lady who honors me by her presence at these lectures has conferred a still further obligation by sending me these two candles which are from Japan, and, I presume are made of that substance to which I referred in a former lecture. You see that they are even far more highly ornamented than the French candles, and, I suppose, are candles of luxury, judging from their appearance. They have a remarkably peculiarity about them, namely, a hollow wick—that beautiful peculiarity which Argand introduced into the lamp and made so valuable. To those who receive such presents from the East, I may thus say that this and such like materials gradually assume a change which gives them on the surface a dull and dead appearance; but they may be easily restored to their original beauty if the surface is rubbed with a clean cloth or silk handkerchief, so as to polish the little rugosity or roughness; this will restore the beauty of the colors. I have so rubbed one of these candles, and you see the difference between it and the other which has not been polished, but which may be restored by the same process. Observe, also, that these moulded candles from Japan are made more conical than the moulded candles in this part of the world.

I told you, when we last met, a good deal about carbonic acid. We found by the lime water test that when the vapor from the top of the candle or lamp was received into the bottles and tested by this solution of lime water (the composition of which I explained to you, and which you can make for yourselves), we had that white opacity which was in fact calcarous matter, like shell and corals, and many of the rocks and minerals in the earth. But I have not yet told you clearly and chemically the history of this substance, carbonic acid, as we have it from the candle, and I must now take you to that point. We have seen the products, and the nature of them, as they issue from the candle. We have traced the water to its elements, and now we have to see where are the elements of the carbonic acid supplied by the candle; a few experiments will show this. You remember that when a candle burns badly, it burns with a smoke; but if it is burning well there is no smoke. And you know that the brightness of the candle is due to this smoke which becomes ignited. Here is an experiment to prove this: so long as the smoke remains in the flame of the candle and becomes ignited, it gives a beautiful light, and never appears to us in the forms of black particles. I will light some fuel which is extravagant in its burning; this will serve our purpose—a little turpentine on a sponge. You see the smoke rising from it and floating into the air in large quantities, and remember now the carbonic acid that we have from the candle is from such smoke as that. To make that evident to you, I will introduce this turpentine burning on the sponge into a flask, where I have plenty of oxygen, the rich part of the atmosphere, and you see that the smoke is all consumed. This is the first part of our experiment, and now what follows? The carbon which you saw flying off from the turpentine flame in the air we have now entirely burned in this oxygen, and we shall find that it will by this rough and temporary experiment, give us exactly the same conclusion and results as we had from the combustion of the candle. The reason why I make the experiment in this manner is solely that I may cause the steps of our demonstration to be so simple that you can never for a moment lose the train of reasoning, if you only pay attention. All the carbon which is burned in oxygen, or air, comes out as carbonic acid, whilst those particles which are not so burned show you the second substance in the carbonic acid, namely, the carbon, that body which made the flame so bright whilst there was plenty of air, but which was thrown off in excess when there was not exygen enough to burn it.

I have also to show you a little more distinctly the history of carbonic and oxygen in their union to make carbonic acid. You have now a right to know this to a far greater extent than before, so I have three or four experiments for that purpose. I have here a jar filled with oxygen, and here is some carbon which has been placed in a crucible, for the purpose of being made red hot. I keep my jar dry, and venture to give you a result imperfect in some degree, In order that I may make the experiment brighter. I am about to put the oxygen and carbon together. That this is carbon (common charcoal pulverized) you will see by

the way in which it burns in air [letting some of the red hot charcoal fall out of the crucible]. I am now about to burn it in oxygen gas, and look at the difference. It may appear to you at a distance as if it were burning with a flame; but it is not so. Every little piece of charcoal is burning as a spark, and whilst it so burns it is producing carbonic acid. I specially want these two or three experiments to point out what I shall dwell upon more distinctly by and by—that carbon burns in this way and not as a flame.

Instead of taking many particles of carbon to burn, I will take a rather large piece, which will enable you to see the form and size, and to trace the effects very decidedly. Here is the jar of oxygen, and here is the piece of charcoal, to which I have fastened a little piece of wood, which I can set fire to and so carry on the combustion, which I could not conveniently do without. You now see the charcoal burning, but not as a flame (or if there be a flame, it is the smallest possible one, which I know the cause of, namely, the formation of a little carbonic oxyd close upon the surface of the carbon). It goes on burning, you see, slowly producing carbonic acid by the union of this carbon or charcoal (they are equivalent terms) with the oxygen. I have here another piece of charcoal, a piece of bark, which has the quality of being blown to pieces—exploding—as it burns. By the effect of the heat, we shall reduce the lump of carbon into particles that will fly off; still, every particle, equally with the whole mass, burns in this peculiar way—it burns as a coal and not like a flame. You observe a multitude of little combustions going on, but no flame. I do not know a finer experiment than this to show that carbon burns with a spark.

Here, then, is carbonic acid formed from the elements. It is produced at once, and if we examine it by lime water, you will see that we have the same substance which I have previously described to you. By putting together 6 parts of carbon by weight (whether it comes from the flame of a candle or from powdered charcoal) and 16 parts of oxygen by weight, we have 22 parts of carbonic acid; and as we saw last time, the 22 parts of carbonic acid combined with 28 parts of lime, produce common carbonate of lime. It you were to examine an oyster shell and weigh the component parts, you would find that 50 parts would give 6 of carbon and 16 of oxygen combined with 28 of lime. However, I do not want to trouble you with these minutiæ; it is only the general philosophy of the matter that we can now go into. See how finely the carbon is now dissolving away [pointing to the lump of charcoal burning quietly in the jar of oxygen]. You may say that the charcoal is actually dissolving in the air round about, and if that were perfectly pure charcoal, which we can easily prepare, there would be no residue whatever. When we have a perfectly pure cleansed and purified piece of carbon, there is no ash left. The carbon burns as a solid, dense body, that heat alone cannot change as to its solidity, and yet it passes away into vapor that never condenses into solid or liquid under ordinary circumstances; and what is more curious still is the fact that the oxygen does not change in its bulk by the solution of the carbon in it. Just as the bulk is at first, so it is at last, only it has become carbonic acid.

There is another experiment which I must give you before you are fully acquainted with the general nature of carbonic acid. Being a compound body, consisting of carbon and oxygen, carbonic acid is a body that we ought to be able to take asunder. And so we can. As we did with water, so we can with carbonic acid—take the two parts asunder. The simplest and quickest way is to act upon the carbonic acid by a substance that can attract the oxygen from it and leave the carbon behind. You recollect that I took potassium and put it upon water or ice, and you saw that it could take the oxygen from the hydrogen. Now, suppose we do something of the same kind here with this carbonic acid. You know carbonic acid to be a heavy gas; I will not test it with lime water, as that could interfere with our subsequent experiments, but I think the heaviness of the gas and the power of extinguishing flame will be sufficient for our purpose. I introduce a flame into the gas, and you will see whether it will put it out. You see the light is extinguished. Indeed, the gas may, perhaps, put out phosphorus, which you know has a pretty strong combustion. Here is a piece of phosphorus heated to a high degree. I introduce it into the gas, and you observe the light is put out, but it will take fire again in the air, because there it re-enters into combustion. Now let me take a piece of potassium, a substance which, even at common temperatures can act upon carbonic acid, though not sufficiently for our purpose, because it soon gets covered with a protecting coat; but if we warm it up to the burning point in air, as we have a fair right to do, and as we have with phosphorus, you will see that it can burn in carbonic acid; and if it burns, it will burn by taking oxygen, so that you will see what is left behind. I am going, then, to burn this potassium in the carbonic acid as a proof of the existence of oxygen in the carbonic acid. [In the preliminary process of heating, the potassium exploded.] Sometimes we get an awkward piece of potassium that explodes, or something like it, when it burns. I will take another piece, and, now that it is heated, I introduce it into the jar, and you can perceive that it burns in the carbonic acid—not so well as in the air, because the carbonic acid contains the oxygen combined, but it does burn and takes away the oxygen. If I now put this potassium into water, I find that besides the potash formed (which you need not trouble about) there is a quantity of carbon produced. I have here made the experiment in a very rough way; but I assure you that if I were to make it carefully, devoting a day to it instead of five minutes, we should get all the proper amount of charcoal left in the spoon, or in the place where the potassium was burned, so that there could be no doubt as to the result. Here, then, is the carbon obtained from the carbonic acid, as a common black substance; so that you have the entire proof of the nature of carbonic acid as consisting of carbon and oxygen. So now, I may tell you that whenever carbon burns under common circumstances, it produces carbonic acid.

Suppose I take this piece of wood, and put it into a bottle of lime water, I might shake that lime water up with wood and the atmosphere as long as I pleased, it would still remain clear as you see it; but suppose I burn the piece of wood in the air of that bottle. You, of course, know I get water. Do I get carbonic acid? [The experiment was performed.] There it is, you see; that is to say, the carbonate of lime, which results from carbonic acid, and that carbonic acid must be formed from the carbon which comes the wood, from the candle, or any other thing. Indeed, you have, yourselves, frequently tried a very pretty experiment, by which you may see the carbon in wood. If you take a piece of wood and partly burn it, and then blow it out, you have carbon left. There are things that do not show carbon in this way, A candle does not so show it, but it contains carbon. Here, also, is a jar of coal gas, which produces carbonic acid abundently—you do not see the carbon, but we can soon show it to you. I will light it, and as long as there is any gas in this cylinder it will go on burning. You see no carbon, but you see a flame, and because that is bright it will lead you to guess that there is carbon in the flame. But I will show it to you by another process. I have some of the same gas in another vessel, mixed with a body that will burn the hydrogen of the gas, but will not burn the carbon. I will light them with a burning taper, and you perceive the hydrogen is consumed, but not the carbon, which is left behind as a dense black smoke. I hope that by these three or four experiments you will learn to see when carbon is present, and understand what are the products of combustion, when gas or other bodies are thoroughly burned in the air.

Before we leave the subject of carbon, let us make a few experiments and remarks upon its wonderful condition, as respects ordinary combustion. I have shown you that the carbon ih burning burns only as a solid body, and yet you perceive that after it is burned it ceases to be a solid. Thare are very few fuels that act like this. It is in fact only that great source of fuel, the carbonaceous series, the coals, charcoals, and woods that can do it. I do not know that there is any other elementary substance besides carbon that burns with these conditions, and if it had not been so, what would happen to us? Suppose all fuel had been like iron. which, when it burns, burns into a solid substance. We could not then have such a combustion as you have in this fireplace. Here, also, is another kind of fuel which burns very well—as well as, if not better than, carbon—so well, indeed, as to take fire of itself when it is in the air, as you see. [Breaking a tube full of lead pyrophorus.] This substance is lead, and you see how wonderfully combustible it is. It is very much divided, and is like a heap of coals in the fireplace; the air can get to its surface and inside, and so it burns. But why does it not burn in that way now when it is lying in a mass? [Emptying the contents of the tube] Simply because the air cannot get to it. Though it can produce a great heat, the great heat which we want in our furnaces and under our boilers, still that which is produced cannot get away from the portion which remains unburned underneath, and that portion, therefore, prevented from coming in contact with the atmosphere, and cannot be consumed. How different is that from carbon! Carbon burns just inthe same way as tnis lead does, and so gives an intense fire in the furnace, or whenever you choose to burn it; but then the body produced by its combustion passes away, and the remaining carbon is left clear. I showed you how carbon went on dissolving in the oxygen, leaving no ash; whereas, here [pointing to the heap of pyrophorus] we have actually more ash than fuel, for it is heavier by the amount of the oxygen which has united with it. Thus, you see the difference between carbon and lead or iron, if we chose iron, which gives so wonderful a results in our application of this fuel, either as light or heat. If when the carbon burnt here the product went off as a solid body, you would have had the room filled with an opaque substance, as in the case of the phosphorus; but when carbon burns, everything passes up into the atmosphere. It is in a fixed, almost unchangeable condition before the combustion; but afterwards it is in the form of gas, which it is very difficult (though we haue succeed) to produce in a solid or liquid state.

[To be concluded.]

# Correspondence.

[Correspondents, in all cases, should sign their communications with their names and address in full—not necessary for publication, but as a guarantee of good faith.—Eds.

### The St. John and Cartwright Purification: Results at Harlem on an Immense Scale.

Office of N. Y. Gas Works,
Ave. A, and 21st Street, Dec. 18, 1870.

Messrs. Editors: Aa you have appreciated so well the efforts, which have been earnest on our part, to improve and cheapen the purification of gas from sulphurous and other coals, we take the liberty to send you a statement from Mr. McGown, the President of the Harlem Gas Light Co., which you may find worthy of publication. At the Works of this Company our compositions have been iu exclusive use for a number of months. Respectfully,

Wm. H. St. John.
Peter Cartwright.

---

Office of the Harlem Gas Light Co.,
78 Nassau St, N. Y., Dec. 12th. 1870.

Messrs. St. John and Cartwright.

Gentlemen: We have been using your method of purification at our Works since March last, and find that it works in a very satisfactory manner.

The difficulties heretofore attending the purification at these Works with ltme alone, for want of surface in the purifiers, has been entirely overcome by this process.

We are now passing over 500,000 cubic feet of gas per day (made from Murphy Run, Penn, and Cannel coals), through purifiers twenty by twenty-five feet, and changing once in from seven to ten days, with a saving of at least twenty-five per cent of labor.

These facts speak well for this process, and I cheerfully reccommend it to the various gas companies as an economical and lasting purifying process.

Respectfully yours,
Henry P. McGown, President.

---

[The above statcment, of an official kind, from the Harlem President, is peculiaaly acceptable to us; for the reason that doubtless many readers may have inciined to the opinion, that our strong endorsement of these improvements in purification have been tinctured with enthusiasm. The above, though worded with characteristic caution and commendable reserve, will be found on examination to justify, in a very satisfactory manner, all that we have said of late concerning the great value, and in fact the indispensable character of St. John and Cartwright's inventions. Resultsof a still more striking character are being obtained elsewhere, which we shall soon be able to report. We consider it our duty to urge upon the whole Gas Community, this highly meritorius American invention, which is so exactly adopted to American needs.—Eds.]

### Gas Explosion at Worcester, Mass.

Providence, December 21, 1870.

Messrs. Editors: I enclose to you extract from Wooster paper, containing account of the terrible explosion at the Wooster Gas Works. The diagram showing the premises, is a correct one.*

The cause of this explosion was the entrance into the basement of the purifying house with a lighted lantern. This basement was entirely tight, and gas had been escaping into it from one of the purifiers, through a three-inch pipe for some time. It seems that tar and light oils had been thrown into the puriers, by the exhauster, in large quantities, and to get rid of this, holes had been cut in the bottoms of the purifyers, and three-inch pipes attached to them for drawing off this tar and oil. These pipes were opened and closed by three-inch cocks and drained the tar, etc., into the well under the center seal, the ends being left about one foot *above the liquid in the well*. This, of course, made these pipes dangerous, as any

* For full abbount of explosion, see page 3.

neglect to close these cocks would at once fill the house with gas. One of these cocks on the "off purifier" was left open, and when the gas was turned on to the purifier, the escape was from this pipe, which not being sealed in the well when it dripped, filled the house and caused the explosion.

Yours truly,
A SUBSCRIBER.

### Oo Subways for Gas Pipes.

SAN FRANCISCO GAS WORKS,
October 22, 1870.

R. H. SINTON, ESQ.,
San Francisco.

Dear Sir: I have been informed that the Board of Commissioners for the construction of the new Montgomery avenue, are considering the propriety of arranging a subway through its length, for the reception of the gas and water pipes. The purpose of this note is to call to the attention of yourself and your associates in the commission, the fact that this method has been subjected to thorough practical test, and condemned as being most unsafe.

It has been found to be impossible to lay a system of gas main and service pipes so that they shall be absolutely tight, and the loss by leakage is an acknowledged and calculated drain upon the profits of every gas company. The tendency of what gas escapes in this way is to follow along the exterior of the pipe (by preference on the ascending grade), until it finds vent either in the open air, or in some underground cell or chamber. In the latter case it forms an explosive mixture, with eight or ten times its volume of common air, and, unless carried off by suitable ventilation, constitutes a magazine which must explode with disastrous effect, if flame or spark be applied. The explosion of the cistern on the corner of Bush and Montgomery streets, about two years ago, completely illustrates the above remarks.

Belgrand, engineer-in-chief of the *ponts* and *chaussees* of Paris, considers it dangerous to place gas pipes in subways or sewers, "in any city where the life of man is taken any account of," as the explosion in the gallery under the bridge of Austerlitz goes to prove.

In this instance "one man was killed and three were wounded; the pavement was blown up along the whole length of the bridge, the water main was burst, and damage done to the extent of £10,000." This was in 1865.

Another instance occurred two years later in Toulouse, in which the gas main was laid along the outside of the subway, and the explosive mixture formed in the subway by the leakage of gas through the wall. The results were even more fatal in this case than in the preceding.

It is next to impossible to ventilate a subway so completely as to avoid this risk, and this has led to the total abandonment of the plan in Paris, where the ablest engineering ability was brought to bear upon the difficulty.

My impression is that gas pipes are so laid in the tunnel executed some three years since by the Metropolitan Board of Works, under the Thames embankment, but I have no records of the matter at hand.

By the erection of a ventilating shaft at the highest point of the profile of the avenue, a greater approach to safety will undoubtedly be secured than is possible in a level street; but against this advantage should be weighed the probable escapes due to earthquake shocks, and the great risk which must occur before any effectual remedy could be applied in such a case.

Very respectfully,
JAMES R. SMEDBERG,
*Consult'g Eng'r San Francisco Gas Works.*

[We publish the above letter by permission, in order that our readers may learn the objections that may be urged against the system of subways, which we recently advocated in an editorial in No. 10, dated November 16, 1870. That the single objection to the employment of subways for gas mains, of the liability to the formation of an explosive compound in the way by the leakage of gas, should neutralize all the advantages to be gained by the adoption of subways is a pity; and we believe the engineering talent of the country is capable of overcoming this difficulty. In fact the plan hinted at by Mr. Smedberg, fully carried out, it seems to us would accomplish the desired result. The "ventilating shaft" if of sufficient altitude, will create an upward draft, and ventilate a level street and the lowest levels, if placed at intervals.

The well known automatic rotary ventilator might be attached to the ventillating shafts to still more efficiently insure an upward draft. The adoption of this plan would be excellent in a sanitary point of view, not only for subways for gas mains but for sewers, or for both combined; because the noxious odors which now emanate from the drainways at the crossings of almost every street to poison the atmosphere that we are obliged to breathe, would be carried above the tops of the buildings, and like the chimney smoke dissipated, when it would do no harm.—EDS.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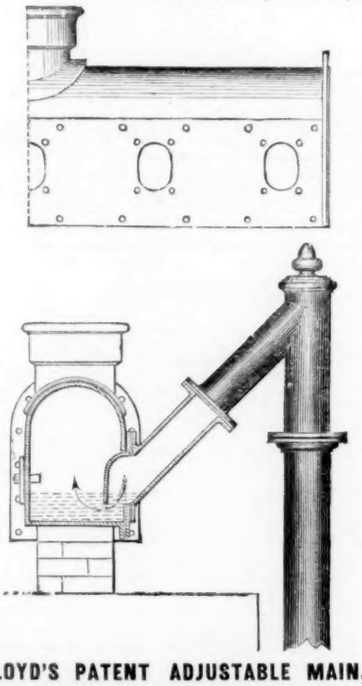

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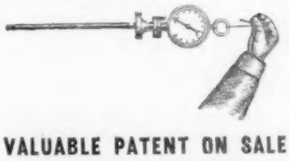

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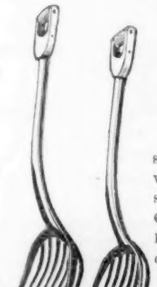

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CONSULTING CHEMIST, GEOLOGIST AND GENERAL SCIENTIST—
**PROFESSOR HENRY WURTZ.**

[NOTE BY PROFESSOR WURTZ.—Contributions and items for which I am, as a Scientist, individually responsible, will have attached my full name or initials.—H. W.]

MONDAY, JANUARY 2, 1871.

WISHING TO MAKE THIS JOURNAL an organ of intelligent discussion to those of our readers who may wish to gain or give information on the subject to which its columns are devoted, the publishers solicit letters from all among them who make the study of these subjects a pleasure, or a profession.

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# General Editorial.

## A NEW VOLUME—A NEW DRESS.

A new volume commences with the present number. It will be, as heretofore, our constant and unceasing aim to keep our readers fully advised of all that may occur in the way of Science and Art, and the specialties to which this Journal is devoted, during the ensuing year, and to bring to our aid every possible facility to render the new volume more and more interesting and valuable, and we feel confident that both readers and patrons will realize and appreciate the efforts we have made, in order that we might give them a Journal unsurpassed by any other journal of like nature in either Europe or America.

The first great step by way of improvement is a complete new dress for the Journal, from the well known type-founders Messrs. Duchy & Co., of this city. This involves a large outlay of money, but we cheerfully make it to benefit the appearance and style of the paper, and please our readers.

We therefore anticipate a large increase over the circulation of the past year, liberal as that has been. Those who desire to subscribe will appreciate the importance of doing so early, so as to be sure of all the numbers,

We make our *conge* by wishing all "A Happy New Year."

## ENRICHMENT OF GAS: THE TRINIDAD BITUMEN.

In our last issue, it was stated that further facts and views would in this be put forth, in relation to this enriching agent. Before proceeding to do this, it is necessary to point out a huge mistake which somehow crept into the hasty computations, before presented. Instead of only 47,000,000 of tons, a more careful calculation shows the mass of this mineral known to exist by actual boring, to be no less than 142,000,000 tons, of 2240 lbs. It will be curious and interesting to calculate further the *weight of spermaceti* to which this vast mass is equal to in candle power, taking as a basis the second experimental result of Mr. FARMER, as quoted below. According to this, one ton of the bitumen is equal to 1,112 lbs. of spermaceti, and the whole lake therefore to *seventy and a half million tons of sperm.* This ought to save the lives of a great many whales. This little calculation is presented merely as an illustration of the magnitude of the boon which has here been offered to mankind, and of the impossibility that this great treasury of light should be longer allowed to lie there comparatively untouched, and with its capacity of adding to the comfort and to the wealth of mankind, altogether undeveloped.

In the former article a brief extract was given of results of investigations made in Great Britain, the general summing up being that the Trinidad Bitumen had there proved practically, in the hands of skilled gas-chemists, to be "very nearly equal," in candle-power at least, to Boghead. It is now proposed to present data obtained by recent similar experiments of our own skilled gas engineer, Mr. WILLIAM FARMER. The following is the substance of the report of this gentleman:

NEW YORK, 42 PINE STREET
Novembeh 12th, 1870.

GEORGE STOKER, Esq., President.
New York and Trinidad Bitumen Co.
21 Nassau Street.

Dear Sir: I have tested the Trinidad Bitumen you placed in my hands, and the following are the results, with my remarks thereon:

With a low heat in an iron retort, and a charge of 112 lbs. of Bitumen, 358 cubic feet of gas were obtained, which was at the rate of 7160 cubic feet per ton, and the illuminating power was 41.81 candles.

With a low heat, and a charge of 56 lbs., we obtained 214 cubic feet of gas, which was at the rate of 8560 cubic feet per ton, and the illuminating power 37.89 candles.

The maximum yield with a high heat was at the rate of 12,400 cubic feet per tun.

One bushel of lime purifies 1,365 cubic feet of the gas.

The coke is worthless as a fuel.

ANALYSIS.

| | |
|---|---|
| Volatile Matter | 59 |
| Fixed Carbon, etc. | 41 |
| | 100 |

The per centage of volatile matter is very large, and it certainly indicates that a much larger volume of gas or candle power may be obtained from the Bitumen, when worked on a large scale in clay retorts.

Yours Respectfully.
WILLIAM FARMER.

As above stated the second result of Mr. FARMER makes the material, by the computation of the present writer, equivalent per ton to 1,112 lbs. of sperm candles. According to investigations set forth in a memoir (yet unpublished) prepared some two years since, by the writer in conjunction with Prof. SILLIMAN, Boghead is equivalent per ton to 1,235 lbs. of sperm; to which may be added that on the same authority Westmoreland coal is found equivalent to 541 lbs. sperm per ton, or rather less than half of the Trinidad. Wigan cannel we found equivalent to about 627 lbs. sperm, and Newcastle coals to average about 540 lbs., the same as Westmoreland.

Mr. FARMER'S figures suggest some further comparison with the English results, to make the whole subject clear. For this purpose it is necessary to refer back to the Reports of Drs. LETHEBY, KEATES, and ANDERSON, which were quoted (at second hand) in our former article. We find that KEATES and LETHEBY made two series of experiments, one with the West Leverson coal and 20 per cent., the other with the same Newcastle coal and 10 per cent. of the bitumen; the first yielding 17.6 and the second 15.6 candle gas. It is suggested to us by Mr. FARMER that if this West Leverson coal be taken as 12.5 candles (which he believes to be about its value) simple calculation shows that these English experiments give for the gas from the bitumen figures very near to (certainly quite equal to) those he himself obtained. Thus:

$$\frac{17.5 \times 100 - 12.5 \times 80}{20} = 37.5 \text{ candles; and}$$

$$\frac{15.6 \times 100 - 12.5 \times 90}{10} = 43.5 \text{ candles;}$$

and in the case of Dr. ANDERSON, his experimental mixture was North Pelton (Newcastle), which he found by special experiment worth 11 candles, with 20 per cent. of the bitumen, and obtained gas of 16.5 candles; giving for the bitumen

$$\frac{16.5 \times 100 - 11 \times 80}{20} = 38.5 \text{ candles.}$$

The mean of Mr. FARMER'S two results is 39.85, while that of these three indirectly obtained British results, is 39.80.

It was also stated in our former notice of this subject, that the Brooklyn Gas-Light Company are now obtaining results in practice which even more than verify the figures obtained in the working tests of these eminent experts. It is, however, by a peculiar mode of manipulation that this is accomplished; and it could be by no means claimed that, in the present state of our knowledge of this comparatively new, and in many respects very peculiar material, all will *at once* succeed in using it to such advantage as to

make it comparable with materials like albertite and boghead. It is, nevertheless, not to be forgotten, in assuming this, that a comparison with these materials is of no *practical* importance whatever, inasmuch as these are now absolutely not attainable, at any price within economical bounds. It is within our knowledge, for example, that a first class Gas Company, desiring lately to obtain a renewed supply of albertite, found that they should have to pay as much as $32 per ton, and therefore abandoned its use. Too much stress cannot be laid upon the fact that the supply of the Trinidad mineral is not liable to this sort of uncertainty, and that if the enterprise of the gentlemen who have introduced it to our notice (just "in the nick of time," as it would appear), meet with the appreciation which it doubtless will, from the gas community, stocks of this enricher can easily be kept on hand which will render such disappointments and embarrassments wholly unnecessary. We shall not attempt to enter upon a critical description of the methods adopted in Brooklyn, in the utilization of the Trinidad bitumen. It is by no means certain, or even probable, that these plans would be the best under other circumstances, as for example in smaller works; and the personal observation and experience of those who adopt its use will furnish by far their best guide. No one interested should wait, with the idea of profiting by the experience of all others, acting upon the too familiar fallacy of "not going into the water till he knows how to swim"; but should take the first opportunity of trying the new material himself. We shall thus rapidly obtain a practical knowledge of all its peculiarities, and have the data on which to specify how it should be used to to the best advantage under variable circumstances, as with different coals, and so on.

The general conviction which we are forced to, by mature consideration is, that the Trinidad bitumen is a material that has been brought into our market just in time to supply an imperative want; that it cannot fail to come rapidly into extensive use for enriching gas; and that those who stand in need of reliable supplies of such a material, and fail to test this one, fairly and thoroughly, on a manufacturing scale, as soon as opportunity offers, will fail in the duty they owe to the public. H. W.

## AN ANCIENT WORK ON GAS.

Mr. Charles Collier, of Selma, Alabama. has presented us with a work entitled "Some information Concerning Gas Lights," by Thomas Cooper, Esq., Philadelphia. Published by John Conrad & Co. J. Maxwell, Printer, 1816."

In this quaint old work the author in his preface, says: "The general adoption of the plan of lighting streets, manufactories, warehouses, and shops in London, by means of inflammable air, which is expelled from coal by distillation, has excited so much enquiry and conversation, that I have deemed it a fit opportunity to publish some information on a subject which is not well understood among us."

He goes on to state in another place that "No gas-light system has been adopted in America," and then gives the well known history of the first discovery of, and application of "gas from coal" for the purposes of illumination.

To show what a small affair Philadelphia was at that time, we quote again: "In this city dimly lighted by 1,200 to 1,300 lamps, some improvements in illumination is obviously desirable." "Oil is growing more scarce and dear, and temptations to uncomfortable parsimony in lighting our streets are every day stronger."

Mr. Cooper evidently foresaw the coming opposition to the improved light, which was at one time very strong, owing to the fear entertained by "dealers in oil, and makers of candles," that their business would suffer thereby. He says, they "may be somewhat effected eight or ten years hence by the general introduction of gas lights, should this take place; but no improvement can be introduced which will not partially interfere with former articles of consumption and modes of manufacture."

At that time it seems Pennsylvania had not even learned the use of that staple, *coal*, which now forms the great mining industry of the State, for he says: "Indeed there is one reason for introducing gas lights here, which does not exist in England! In that country the precious article, coal, the foundation of all manufacture, is in universal use, and esteemed as it deserves. Here we know not yet its value. We do not use it at all in the form of coke for our iron furnaces; we hardly know the use of it for steam engines; it forces its way very slowly as fuel in our stoves and houses; we use none of the coal tar for vessels; and in fact it is to the generality of our people a substance whose great value is experimentally unknown. Whatever tends to bring it into public estimation, will be a public benefit; *for the seat of wealth and influence will ultimately be placed in every civilized country, where* CANALS *centre and coals abound.*"

We italicize the latter part of the last sentence and emphacise "canals," for it shows that our slow country at that time did not dream of the revolution to be brought about in our carrying trade by the coal burning "locomotive," and its railway of iron and later, still of steel.

We shall have occasion to quote from this book again. It is a valuable acquisition to our library of gas literature, and we have taken occasion to thank the donator, the gentlemanly superintendent of the Selma Gas Works of Alabama.

## The New Series of "Silliman's Journal."

As we go to press we have the first (January) number of the new monthly series of the *American Journal of Science and Arts;* which was editorially announced in our last. (See our advertising columns also.) We take the occasion to urge, with earnestness, upon all our readers and patrons, that they should be also readers and patrons of this oldest of the American scientific serials. *Silliman's Journal*, as it is universally termed, with us, in cordial recognition of the immense claims of both the elder and the younger SILTIMAN, to the gratitude of American men of science, in consideration of their life-long labors on this Journal—labors performed not only "without money and without price," but which would have been beyond the command of money, and are priceless—has been far from advancing in circulation with the advancing population and wealth of our country. This is doubtless to be explained in a measure by the fact that Science—true Science—has not, sad to say, during ihe last two or three decades, accomplished any such advancement in this country as is commensurate or comparable with that of our population. On the contrary, indeed, there is great ground for the shameful suspicion that American Science has *retrograded* during this period. A most tyrannical power, that we have called *Practicality*, has ruled us all, whose Procrustean practice of reduction of all things to its own sordid and shoddyish level, has been generally too strong for the scientific ambition of Young America. As the little ink *we* might here shed, even together with our tears, on this subject, would be but a drop in the flood that will be needed to wash out this spot, we shall refrain.

To return—*Silliman's Journal* deserves well to an eminent degree of all friends of scientific progress; among whom we are sure we can class the whole of so intelligent a body as our American Gas Fraternity; and the publishers now desire to increase its subscription list, and advertising patronage, in order that they may be able to add largely to its usefulness. They have already themselves taken the initiatory by doubling the frequency of issue of the publication, and we commend it as a Journal in which no one can fail to find frequently matter of the utmost interest and reliability. This is a subject we shall not allow to rest, though space fails us now.—H. W.

☞ "SMEDBERG'S SYNOPSIS OF BRITISH GAS-LIGHTING" will be the most COMPLETE and EXHAUSTIVE work ever published on GAS, etc., etc. including a SYNOPSIS OF PATENTS AND IMPROVEMENTS. Subscription price $15, payable when published and ready to deliver. Address M. L. CALLENDER & Co., 42 Pine street, N. Y. See advertisement on page

☞ H. THOMPSON, No. 70 East Broadway, New York, is the address desired by many who are inquiring for Wheeled and Reclining Chairs for Invalids, of improved modern construction.

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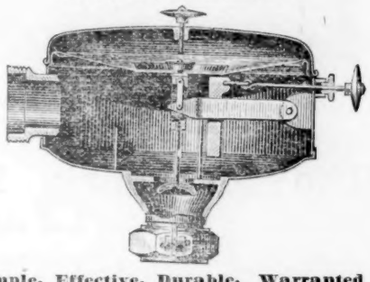
GAS PRESSURE GOVERNOR.

(PATENTED MAY 5TH, 1868.)

Manufactured by

E. BEGGS, Paterson, N. J.



Simple, Effective, Durable. Warranted to work satisfactorily when the directions are followed.

The above cut represents a sectional view of this Governor, fully described in No. 262 of this Journal, Nov. 16, 1870.

It is made almost entirely of brass; the diaphragm is selected from choice leather, and covered with a preparation which keeps it flexible, as well as gas-tight and durable, for upwards of five years, when it can be renewed at a trifling expense, and the apparatus is again as good as new.

The printed directions attached enable any one not skilled in the business to set them to work, and, also give the necessary information about the pipe, burners, &c.

The sizes of the Governors correspond to those of the gas meters, and before ordering, it is necessary to find the size required. They can be connected at any other place if thought best.

Numberless testimonials can be shown to prove that it saves from 20 to 50 per cent. of gas, besides improving the character and steadiness of the light.

Address, EUGENE BEGGS,
Gas Engineer, Paterson, N. J.
Or, M. L. CALLENDER, 42 Pine Street, N. Y.

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WHITE LUBRICATING, MACHINERY, PARAFINE AND KEROSENE OILS,

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A SYNOPSIS OF

British Gas Lighting.

TO BE PUBLISHED SHORTLY.

"WINNOWED.—The wheat carefully preserved, and the chaff thrown away."

This work will comprise the essence of the London *Journal of Gas Lighting*, from February 10, 1849, to December 31, 1867, and afford a succinct resume of the entire English Gas Engineering between these dates.

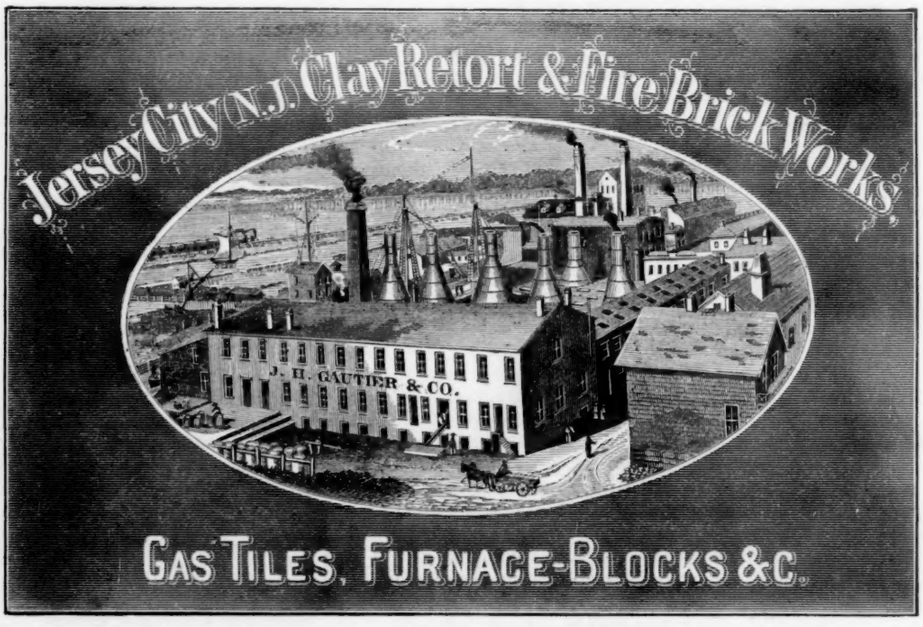
The excerpts will, as far as possible, be symmetrically arranged under the heads of Coals, Distillation, Purification, Volumetry, and Photometry.

It is to be executed by James R. Smedberg, Engineer San Francisco Gas-Light Company. Subscriptions should be addressed to the offices of the AMERICAN GAS-LIGHT JOURNAL, 42 Pine street, Room 18, New York.

It will be issued only to subscribers.

It will be of great value, not only to Gas Companies and Engineers, but to those who represent the enormous collateral interests of Gas-Lighting—to Chemists, Gas-Fitters, and Patentees, as well as to scientific men generally.

Subscription price, $15.

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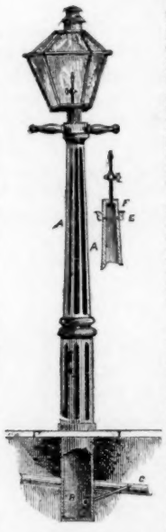
**PATENT LAMP POST!**

ANTI-FREEZING.



MORE SIMPLER, MORE CHEAP, MORE USEFUL, LESS LIABLE TO GET OUT OF ORDER, and gives a more PERFECT LIGHT than any other Lamp Post known. It is the only really ANTI-FREEZING LAMP POST ever offered to the public. The improvement is applicable to OLD POSTS at a TRIFLING COST.

This invention consists mainly in dispensing with the interior gas pipe, by simply closing the bottom of the Lamp Post and tapping it five inches from the bottom for the service pipe.

The top is fitted with a plug or stopper to take in a short piece of pipe with the stop-cock and burner. The interior of the Post thus forms a large gas chamber and condenser for all moisture and impurities which fall to the bottom, leaving the gas free and pure at the burner.

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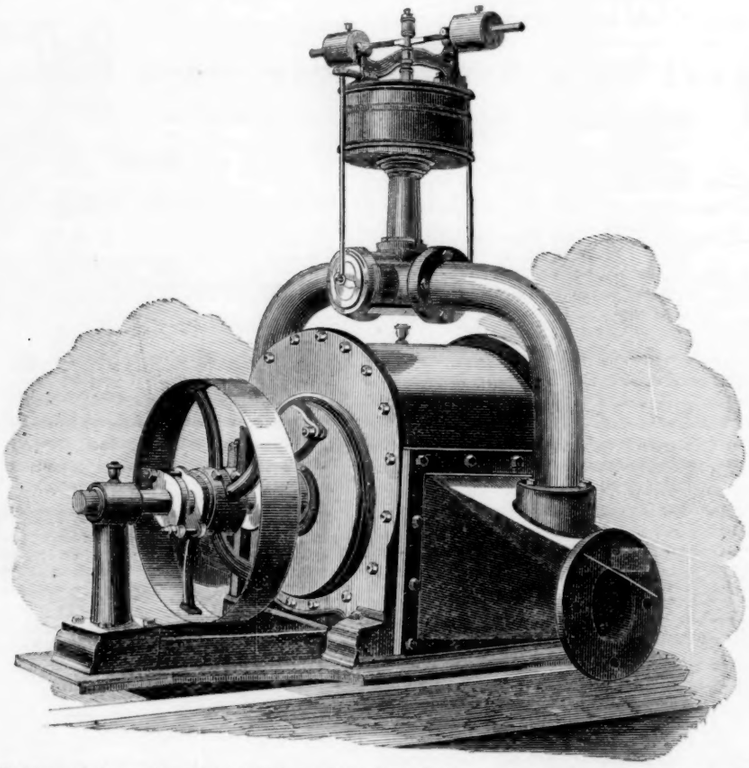
SMITH & SAYRE MANUFACTURING COMPANY.

**The Mackenzie Patent Gas Exhauster**

**And Patent Compensator.**



They are made to pass from 4,000 to 150,000 cubic feet of gas per hour; will increase the production and illuminating power of the gas, and add very much to the durability of the retorts, either clay or iron. The Compensator obviates entirely the necessity of water-joints, is compact, durable, cleanly, not liable to get out of order, self-acting, quiet, and certain in its operation.

We are also sole proprietors and manufacturers of the

MACKENZIE PATENT BLOWER, PATENT CUPOLA AND SMELTING FURNACE.

The Blower is a Force Blast machine, durably built, and can be driven with one-third the power required to drive the ordinary Fan. The Cupolas are manufactured in sizes to melt from 1 to 20 tons per hour, will save one quarter of the time required by the old style Cupola, and 33 per cent fuel. Address

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**Valve Manufacturing Co.**

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Make Valves—Double and Single Gate—¼ inch to 36 inch, for Water, Gas and Steam.

"CINCINNATI, March, 1870.

"I would say that if any certificate or affidavit is desired in relation to the superior character of the Ludlow Valve above others that I have seen, the same will be cheerfully given. I think, however, that the Valve proves for itself.

"JOSEPH MAYER,
"Superintendent Water Works."

"DAYTON, OHIO, June 27, 1870.

"I have to say that we find them always in order—operating easily under all degrees of pressure. In a word, they have given perfect satisfaction in every particular.

"GEORGE LEHMAN,
"Chairman Water Works Committee."

"CANTON, OHIO, June 27, 1870.

"We are now using and have been, since the commencement of our works, your valves, and they are proving entirely satisfactory.

"JOHN S. SHORB,
"Superintendent Water Works."

"PEORIA WATER WORKS, July 1870.

"With pleasure I can testify to their superiority. Their action has been perfect under all degrees of pressure, and have given perfect satisfaction.

"S. A. KINSEY, Ex. Sup't.
"JOHN J. STEIGER, Sup't."

"BROOKLYN GAS LIGHT COMPANY.

"I take great pleasure in saying that they give perfect satisfaction—opening easily and quickly, and requiring no effort to start them; even after they have been closed for months.

"A. F. HAVENS, Engineer."

"OFFICE OF PHILADELPHIA GAS WORKS, 14th June, 1870.

"I am pleased to state that the lot of large Gas Valves bought from you (Hart & Buck), as agents of the Ludlow Manufacturing Co., have given me perfect satisfaction. The double gate water valve, bought for a special purpose, also works admirably. We want no better valves. The Indicator on your valves is a great improvement over the old style.

"THOS. R. BROWN, Engineer."

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Manufacturers of

**CHANDELIERS!**

And Every Description of

GAS FIXTURES,

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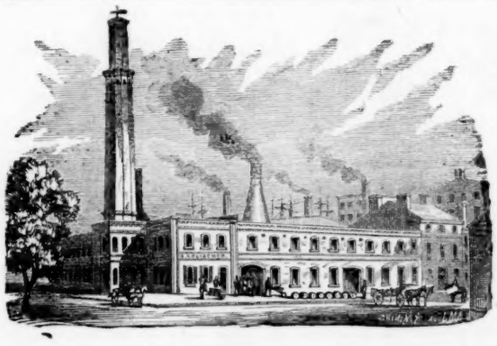
Special designs furnished for Gas Fixtures for Churches, Public Halls, Lodges, &c.



NEW YORK

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## Retort Works.

☞ *Established in 1845.* ☜

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OFFICE,

**58 Goerck Street, cor. Delancy, N. Y.**

*GAS RETORTS, TILES & FIRE BRICK*

Of all shapes and sizes.

FIRE MORTAR, CLAY AND SAND.

Articles of every description made to order at the shortest notice.

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**PHILLIP NEWKUMET,**

(Successor to John Newkumet,)

MANUFACTURER OF ALL KINDS OF FIRE BRICK, GAS HOUSE TILES,

To suit all the different plans in use. Also, Fire Bricks, Blocks, Tiles, etc., etc., for Furnaces, Rolling Mills, Foundries Lime Kilns, Glass Works, etc., etc., of superior quality.

Fire Clay, Ground Brick, Fine Mortar, Fire Sand and Kaolin constantly on hand.

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☞ Plans of Settings for Benches of Threes, Fives, and Sixes furnished, free of charge, upon application.

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Manufactures of

*FIRE BRICK AND TILES,*

Of all shapes and sizes.

FIRE MORTAR, CLAY AND SAND.

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EQUAL TO BOGHEAD CANNEL FOR INCREASING the illuminating qualities of Gas.
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MANUFACTURERS OF ALL THE LATEST AND MOST IMPROVED APPARATUS AND TOOLS FOR THE MANUFACTURE & DISTRIBUTION OF COAL GAS.

☞ WORKS AT THE RAILWAY DEPOTS,

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We manufacture Bench Castings, Washers, "The Immersed Multitubular," and Atmospheric Condensers, Wet and Dry-Lime Purifiers, Dry Center Seals, Telescopic and Single Gas Holders, Wrought Iron Trussed Roof for Iron or Slate, Wood and Iron Trays for Purifiers, Coke and Coal Carts, Wrought Iron Screening Shovels and Castings, and Wrought Work of every description for Gas-Works.

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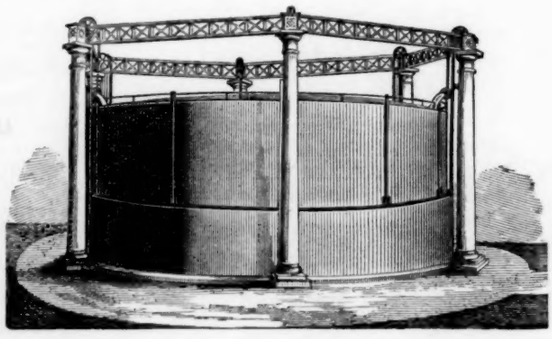

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**Wrought Iron Work for Bridges, Bui dings, Steam Boilers, Tanks, Stills, &c.**

**Particular Attention paid to Alterations and Repairs.**

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BUILDERS OF

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FOR TOWNS AND MANUFACTORIES.

Estimates furnished of the cost of Works, and cost to Manufacture Gas in any Locality.

**Gasholders,**

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EXHAUSTERS AND COMPENSATORS,
IRON AND CLAY RETORTS,
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STATION AND CONSUMERS' METERS.

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FREDERICK GRINNELL, President, J. C. HARTSHORN, Treas
S. MILLETT THOMPSON, Secretary.

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**H. A. BRANCH, Agent.**

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AMERICAN

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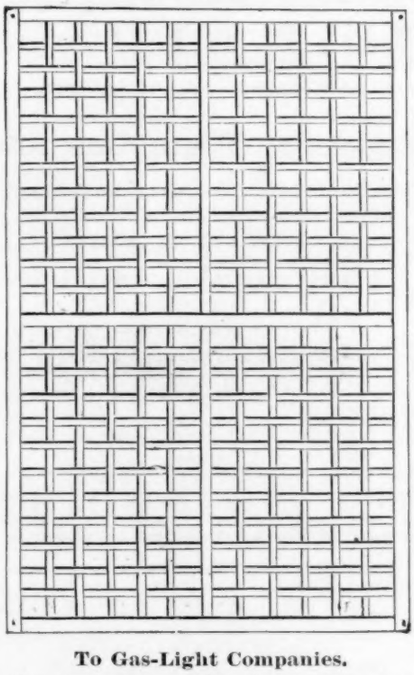

**To Gas-Light Companies.**

Your attention is respectfully called to the new and improved Patent GAS SCREEN, now being manufactured by the American Gas Screen Manufacturing Company, under the patents granted to E. DUFFEE, and are pleased to submit the following points of their excellence and superiority over all other Screens now in use.

The Screen is made with an Oak Frame, interlaced with split rattan drawn through holes at regular intervals in the Frame and cross pieces, the edges of the frame being grooved to prevent abrasion.

The advantages of the Screen are:

1st. The large purifying surface, the construction of the Screen giving over three-fourths of the surface for the gas to penetrate the lime.

2d. On account of the free passage of the gas through the Screen the pressure is reduced, thereby preventing the accumulating of carbon on the retorts.

3d. The saving of lime and labor, as the Screens are not liable to clog, and are easily cleaned.

4th. Their cheapness and simplicity of construction.

5th. Their DURABILITY—they can be used longer than any other now used.

**Testimonials.**

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Mr. E. Duffee—Dear Sir: We have used your Trays for the last five years in our works, and find them to last the longest, and give the best satisfaction of any we have ever used.

Respectfully yours,
WM. W. WEST, Supt.

CHELSEA, July 20, 1870.

Mr. E. Duffee—Dear Sir: I have used your Purifying Trays for three years, with entire satisfaction to our company. For durability and cheapness, I am convinced they are the best with which I am acquainted. By the increased purifying capacity of your Trays, it relieves the pressure on the retorts, and prevents the accumulation of carbon, and also save lime and labor.

J. M. SOMER,
Supt. Chelsea Gas Co.

DORCHESTER, March 3, 1870.

Mr. E. Duffee—Dear Sir: We have had your Gas Trays in constant use for almost one year and six months, and find them superior to any others we have ever used, both in point of economy and efficiency. Truly yours,

W. B. BROOKS,
Agent Dorchester Gas-Light Co.

BANGOR, August 2, 1870.

Edward Duffee, Esq.—Dear Sir: Yours of the 20th ult. is received. In regard to your Gas Trays, I take pleasure in saying that they have been in use over two years, and have given perfect satisfaction, and they are in good order at the present time; should have no hesitation in recommending them, believing they are the most durable and easiest kept in order of any with which I am acquainted.

Respectfully yours,
W. H. PERRY, Supt.

The following Gas Companies are now using the American Gas Screen Company's Screen:

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| Boston Gas-Light Co., Mass. | Fall River Gas-Light Co, Mass. |
| E. Boston Gas-Light Co., Mass | Manchest'r Gas-Light Co.N.H. |
| Chelsea Gas-Light Co., Mass. | Concord Gas-Light Co., N.H. |
| Dorchester Gas-Light Co.Mass | Dover Gas-Light Co., N. H. |
| Roxbury Gas-Light Co., Mass. | Gt. Falls Gas-Light Co., N.H. |
| Jamaica Plain Gas-Light Co., Mass. | Bangor Gas-Light Co., Me. |
| Salem Gas-Light Co., Mass. | Lewiston Gas-Light Co., Me. |
| Lawrence Gas-Light Co. Mass. | Biddeford Gas-Light Co., Me. |
| Haverhill Gas-Light Co., Mass | Provid'nce Gas-Light Co., R.I. |
| Taunton Gas-Light Co., Mass. | Woonsocket Gas-Light Co., R. I. |
| Newburyport Gas-Light Co. Mass. | Meriden Gas-Light Co., Conn. |
| Malden Gas-Light Co., Mass. | Bridgep't Gas-Light Co., Ct. |
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The Company are now able to supply all Gas Companies with the above Screen. A trial is asked and satisfaction is guaranteed. Address,

**American Gas Screen Company,**

**Haverhill, Mass.**

S. D. MAYNARD, President.
GEORGE W. DAY, Treasurer.
LUTHER DAY, Agent.
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**CLARK'S ENAMEL**

FOR

## Gas Retorts and Furnaces,

CHEMICAL APPARATUS,

AND ALL APPLIANCES REQUIRING PRESERVATION FROM A HIGH HEAT.

*INDESTRUCTIBLE, AND WILL NOT CARBONIZE,*

*INPERVIOUS TO GAS, AND ADDS TO THE STRENGTH OF A RETORT.*

COST MODERATE.

Those desiring to test it can do so, free of cost, by communicating with

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THE OFFICE FOR THE SALE OF THE GENUINE **Sabatton's Patent Coke Screening Shovels** is now at 96 MAIDEN LANE, where all orders will be promptly filled.

Recent improvements have made them indispensible to Gas Companies.

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PATENT OFFICE DRAWINGS
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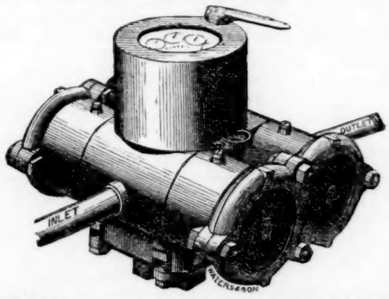
**OFFICE GAS-LIGHT JOURNAL.**

H. R. WORTHINGTON'S



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This Meter is also used for the measurement of Oil—it combines
ACCURACY, SIMPLICITY, and REMARKABLE DURABILITY
With such ease and certainty of motion, as to offer no appreciable obstruction to the flow of water in the pipes to which it is connected, as it runs and registers upon three inches head, or when delivering the smallest stream. These qualities, with its low cost, have caused its extensive adoption by corporations and individuals, in many of our largest cities.

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MANUFACTURERS OF
**Clay Retorts, Fire Brick, Tile, Etc.,**
*OF THE BEST QUALITY.*
ALL SHAPES AND SIZES MAUFACTURED TO ORDER PROMPTLY.
**Lockport, Westmoreland County, Pa.**

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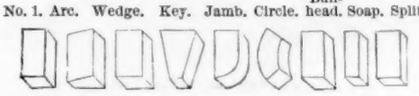
No. 1. Arc. Wedge. Key. Jamb. Circle. Bull-head. Soap. Split.



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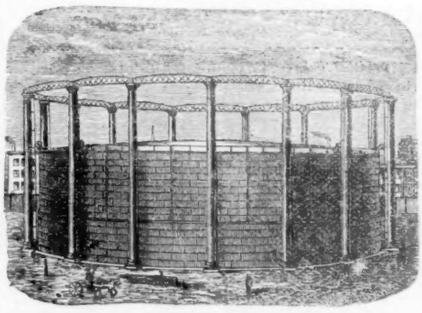

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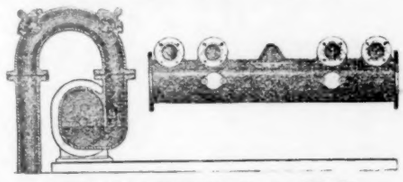

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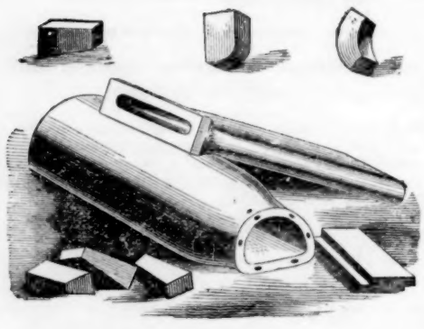



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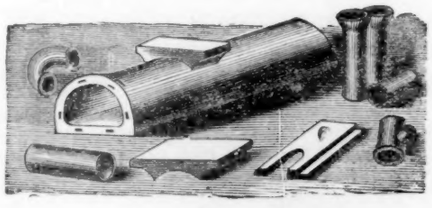

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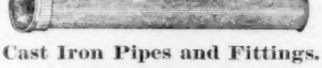

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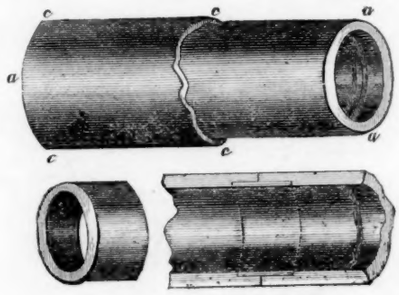

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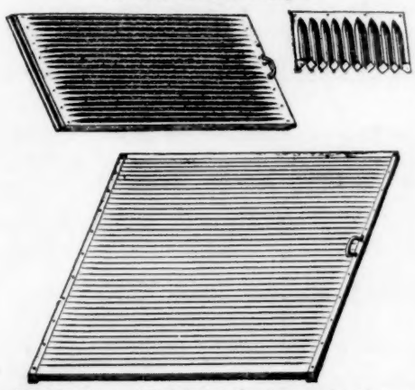

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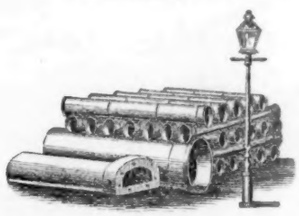

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All Pipe cast vertically in dry sand.

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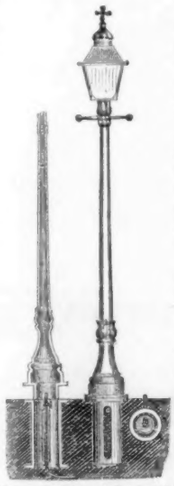

1st. The saving of the base of bottom part of the Post, when the column is broken, the Post being made in two parts. The broken column can be replaced by a new one, without disturbing the base.

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3d. When a stoppage of gas in stand pipe occurs, the column can be lifted out, the pipe detached, cleaned, and replaced in fifteen minutes, no digging being required, as is now done with the old Post.

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**Certificate.**

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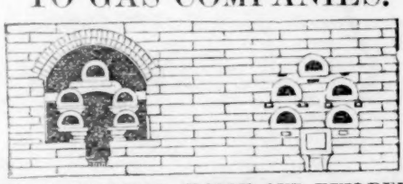

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**GAS HOLDERS.**—Single Lift and Telescopic Gasholders, with Cast or Wrought Iron Suspension Frames.

**GAS GOVERNORS.**—Station Governors, with Regulating and Indicating Columns for Inlet and Outlet Pipes, also Dry Governors with Flexible Diaphragms for Underground Pipes.

**STOP VALVES.**—Double Faced Stop Valves for Gas or Water, from three inches to forty-eight inches diameter. These Valves are proved on both sides, with a heavy Water Pressure, Flange and Bell Pipes, Fittings and Drips of all descriptions. Steam Boilers and Hot Water Apparatus for Heating Building, and Gas Holder Tanks. Lamp Posts and Lanterns.

Best quality American Charcoal Iron Boiler Tubes Wrought Iron Tubes from one-eighth of an inch to ten inches diam., with all kinds of Fittings, Valves and Cocks, Gas and Steam Fitters' Tools, and all articles connected with the manufacture of Gas, Steam or Water.

Sole Manufacturers of P. MUNZINGER's Patent Purifiers, Dry Center Seals, Adjustable Hydraulic Main Stand, Wooden Lime Trays, Stand and Straddle Pipes, and Multitubular Water Condenser.

MR. P. MUNZINGER, Gas Engineer, has been connected with our Establishment as Engineer and Designer, and in charge of the Gas Works Department for the past fifteen years.

Plans, Specifications, and Estimates furnished, for Lighting up Towns, Cities, Factories, and Public Buildings, etc., etc., with Gas from Coal, Rosin, or Wood.

We would refer to the Gas Machinery erected by us, and in operation, at the following places:

Philadelphia, Pa.
Williamsport, Pa.
Altoona, Pa.
Willkes Barre, Pa.
Honesdale, Pa.
Harrisburgh, Pa.
Erie, Pa.
Hanover, Pa.
Easton, Pa.
Lancaster, Pa.
Lock Haven, Pa.
McKeesport, Pa.
Allentown, Pa.
Lebanon, Pa.
Uniontown, Pa.
Washington, Pa.
Hudson City, N. J.
New Brunswick, N. J.
Salem, N. J.
Newark, N. J.
Freehold, N. J.
Englewood, N. J.
Jersey City, N. J.
Elizabeth, N. J.
Camden, N. J.
Flemington, N. J.

Metropolitan Works, N. Y. City.
Binghamton, N. Y.
Rome, N. Y.
Utica, N. Y.
Port Jervis, N. Y.
Elmira, N. Y.
Niagara Falls, N. Y.
Flat Bush, N. Y.
Westchester Co., N. Y.
Batavia, N. Y.
Fredonia, N. Y.
Columbus, Ohio.
Mansfield, Ohio.
People's Works, Cleveland, Ohio.
Newark, Ohio.
Salem, Ohio.
Wooster, Ohio.
People's Works, Chicago, Ill.
Chicago Gas-Light and Coke Co., Ill.
Jacksonville, Ill.
Peoria, Ill.
National Asylum for Discharged Volunteer Soldiers, Milwaukee, Wis.

Detroit, Mich.
La Porte, Ind.
Lawrence, Kansas.
Salem, Oregon.
Port-au-Prince, Cal.
San Jose, Cal.
Stockton, Cal.
Illinois State Penitentiary, Joliet.
Hartford, Conn.
Hagerstown, Md.
Peoples Works, Baltimore, Md.
Elkton, Md.
Milledgeville, Ga.
Augusta, Ga.
New Orleans, La.
Shreveport, La.
Louisiana Ice Manufacturing Co.
Nashville, Tenn.
Murfreesboro, Tenn.
Jackson, Miss.
Houston, Texas.
Galveston, Texas.
And a number of others.


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